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CLINICAL EVALUATION OF PUSKARMULA (INULA RACEMOSA) CAPSULE IN THE PATIENTS OF METABOLIC SYNDROME

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ABSTRACT

Metabolic Syndrome (MS) is a multi-factorial metabolic disorder affecting millions of people worldwide. Insulin resistance and abdominal obesity vice-versa affects each other and it may lead to poorly understood complex set of biological mechanism at cellular level, which play a significant role in the genesis of MS and other associated risk factors. In this perspective Ayurveda strongly focused on two concepts of diseases first one related to outcome of over-nutrition and second one related to under-nutrition. The disease MS is the outcome of over nutrition due to defective tissue metabolism. This study reveals to observe the safety and efficacy of an Ayurvedic drug Cap. Puṣkarmūla in the patients of Metabolic Syndrome. A total 60 patients of MS of either sex were enrolled in the present study and were followed for a period of 3 months with monthly follow ups. The patients were divided in to 3 groups on the basis of their treatment strategies. The study showed significant improvement in BMI (p=0.000) in group B & C, SBP (p= 0.10 in group B & p= 0.001 in group C) and dyslipidemia (p= 0.000 in group B & p= 0.001 in group C for S. cholesterol) in patients of MS.

KEYWORDS: Diabetes Mellitus, Dyslipidemia, Hyperglycaemia, Insulin Resistance, Metabolic Syndrome

INTRODUCTION

The metabolic syndrome consists of a group of metabolic abnormalities that increases risk of Cardio Vascular disease (CVD) and Diabetes Mellitus (DM)[1,2]. MS is also known as Syndrome X or Insulin Resistance syndrome[3,4]. The criteria for the MS have evolved since the original definition by the World Health Organization in 1998[5]. The major features of MS include Central obesity, Hypertriglyceridemia, Decrease High density lipoprotein (HDL), Hyperglycemia and Hypertension[6]. The Metabolic syndrome is common in adult populations all over the world. In Australian adults, its prevalence ranges between 13.4 to 30.7%, depending up on the definition used. In U.S.A its overall percentage in adults was 22.8% for men and 22.6% for women. In Japanese population 51% of male and 53% of female subjects met the WHO criteria for MS, where as 45% of male and 38% of female subjects met the US-NCEP ATP III criteria for Metabolic syndrome. This situation appears to be similar in the Indian subcontinent with recent data suggesting about one fourth to one third of the adult Indian population suffer from the MS. Some community such the Punjabi Bhatia community in north India are more prone to be obese with type 2 DM having symptoms of MS.

The recent data reflects that increased industrialization worldwide is associated with rising rates of obesity, which is anticipated to increase prevalence of the MS dramatically, especially as the population ages.[7] Moreover the rising prevalence and severity of obesity in children is initiating feature of MS in younger population.[8]

It is now known that the unhealthy life style and high caloric diet with sedentary habits causes obesity and insulin resistance which leads to metabolic syndrome in a large population worldwide.[9,10] If the pre diabetic state or full pledged diabetes is ignored, condition of metabolic syndrome emerges, which may transform in to other major cardio vascular complications over a period of some months or years, depending up on the degree of risk factors.[11,12,13]

The purpose of the present study is to introduce an effective and safe Ayurvedic line of management as well as other preventive measures for treatment of metabolic syndrome and to prevent its life threatening major metabolic complications. We have introduced an ayurvedic drug cap. Pushkarmūla in the patients of metabolic syndrome, which acts as adrenergic β blocker and a good drug to control dyslipidemia.[14]

MATERIALS AND METHODS

Aims and Objectives

- To develop Pushkarmūla as a single drug or in combination with ongoing conventional treatment in its associated disorders.
- To study the status of Ojas (immune status) and Agni (metabolic status) in different clinical settings and impact of Pushkarmula on same.
- To evaluate the impact of Deha Prakriti (physical and genetic constitution) on occurrence and treatment response of its associated disorders.

Diagnostic Criteria

Patients of different age group, sex and socio-economic status were selected from the Kayachikitsa OPD & IPD, S.S. Hospital, IMS, BHU, on the basis of following criteria

Inclusion Criteria

- Age 20-70 yrs.
- Patients fulfilling the criteria of MS as described by **NCEP-ATP III**

Exclusion Criteria

- Age <20yrs. and >70yrs.
- Type I and Type II Diabetes Mellitus (NIDDM) with major complications.
- Obese and Hypertensive patients with other major complications.
- Drug or chemical induced diabetes mellitus e.g. Glucocorticoids etc.
- Certain genetic syndromes e.g. Down's syndrome, Klinefelter's syndrome, Turner's syndrome etc.
- Patients suffering from other severe systemic diseases.

Composition and Formation of Drug

It is a stout herbaceous alpine perennial of Asteraceae family, 1.5 m tall, with very large basal Leaves and usually terminally borne, yellow flower heads. The plant is distributed in temperate alpine Himalayas at an altitude of 1,500 - 4,200 from Kashmir to Kumaon, Afghanistan to Central Nepal.

The root is having medicinal properties and considered a specific for cough, dyspnoea, asthma, pleurisy, and chest pain especially pre cordial pain. The root is used as an important ingredient of several polyhedral formulations for heart diseases and inflammatory conditions.

Study Procedure, Dosing Schedule and Duration of Treatment

A total 60 cases of Metabolic Syndrome were selected from OPD and IPD of Kayacikitsa, S. S. Hospital, IMS, B.H.U, Varanasi after thorough history taking, clinical and laboratory examination and they were recruited in to 3 groups.

Group A: Control with ongoing conventional treatment (Cap. Metformin 500 mg O.D to B.D + Tab. Amlodipine 2.5 to 5 mg O.D to B.D + Tab. Atorvastatin 10 to 20 mg O.D)

Group B: Treated with Cap. Pushkarmūla(500 mg) B.D after meal with water.

Group C: Ongoing conventional treatment + Cap. Pushkarmūla(500 mg) B.D after meal with water.

Out of these 60 patients, 56 patients were turned up for full follow ups for the period of three months. All the patients were put on Cap. Pushkarmūla (500 mg), 1 capsule twice daily with Luke warm water 30 minutes after meal for a period of three months with follow up at every month. During the course of treatment no other life styles interventions were enforced.

Criteria for Assessment of Therapeutic Response

Subjective Assessment: On the basis of improvement in clinical symptomatology.

Objective Assessment: Objective assessment was done on the basis of Weight, BMI, FBS, PPBS, Lipid profile, waist circumference, and Blood pressure

Statistical Method

All the data were collected in tabulated form and shown in graphic representation also. The intra-group comparison was done to see the effect of treatment using paired‘t’ test. For the inter-group comparison between different groups ANOVA (one way analysis of variance) was applied and value of F test was determined. Wherever F test resulted statistically significant, post–hoc test was applied for multiple comparisons, identifying significant pairs of groups.

OBSERVATIONS AND RESULTS

In the present study 60 patients were enrolled, out of which 56 patients turned up for full follow ups while 4 patients were dropped out from the study. The observations made in this study are as follow.

The study shows that 35% of total cases having Positive history of DM, HTN, Dyslipidemia and Obesity in their first-degree relatives. Maximum numbers of patients were in the weight range of >75 kg i.e. 58.33%. Body mass index was also calculated to identify the risk and prevalence and it was found that maximum patients (66.67%) were

registered as obese (>30 kg/m^2) followed by 21.67% in over weight category (25.0-29.9 kg/m^2) and 11.66% patient were registered under Normal weight (18.5-24.9 kg/m^2).

This study shows that the incidence and prevalence of different components of Metabolic Syndrome in which obesity is the most common component of MS and it was present in 90% of totally observed cases of Metabolic Syndrome. The second most common component was Hypertension (81.67%), followed by Reduced HDL cholesterol (71.67%), increased fasting blood glucose (68.33%) and Raised Triglyceride levels (63.33%).

Effect of Treatment on BMI: The difference in means BMI was highest in group B (1.07) followed by group C (1.04) and A (0.29) respectively. (Table 1)

Effect of Treatment on SBP: The reduction in means SBP was highest in group C (8.22) followed by group B (7.10) and group A (2.00) respectively. (Table 2)

Effect of Treatment on DBP: The reduction in means DBP was highest in group B (6.53) followed by group A (2.95) and group C (1.61) respectively. (Table 3)

Effect of Treatment on FBS: The reduction in means FBS was highest in group B (8.68) followed by group C (7.72) and group A (1.42) respectively. (Table 4)

Effect of Treatment on PPBS: The difference in means PPBS was highest in group B (13.26) followed by group C (10.22) and A (0.53) respectively. (Table 5)

Effect of Treatment on Serum Cholesterol: Intergroup comparison (One Way ANOVA) did not show a statistically significant ($p>0.05$) changes. But on the basis of mean reduction, maximum response goes in favour of Group B (25.63) followed by Group C (21.72) and Group A (5.84). (Table 6)

Effect of Treatment on Serum Triglycerides: The difference in means S. TGL was highest in group B (27.00) followed by group C (16.83) and A (4.89) respectively. (Table 7)

Effect of Treatment on Serum HDL: Intergroup comparison (One Way ANOVA) did not shows statistically significant ($p>0.05$) change. But on the basis of mean reduction, maximum response goes in favour of Group B (-5.26) followed by Group C (-1.44) and Group A (-0.95). (Table 8)

Effect of Treatment on Serum LDL: Intergroup comparison (One Way ANOVA) did not show statistically significant ($p>0.05$) change. But on the basis of differences in mean, maximum response goes in favour of Group C (16.28) in comparison to Group B (13.32). while in Group A, the response was negative (-1.74). (Table 9)

Effect of Treatment on Serum VLDL: Intergroup comparison (One Way ANOVA) did not show a statistically significant ($p>0.05$) changes. But on the basis of differences in mean, maximum response goes in favour of Group B (9.00) in comparison to Group C (3.11), while in Group A response was negative (-1.84). (Table 10)

Effect of Treatment on Ojas (Immune) Status Score: On intergroup comparison (One Way ANOVA), the result was statistically significant in BT ($p=0.023$) between Group A & B and Statistically highly significant difference ($p=0.000$) in AT between the net changes in Ojas status score between the Group A & B and A & C with the treatment was

observed. The difference in mean was highest in group C (4.61) followed by group B (3.37) and Group A (-0.421) respectively. (Table 11)

Effect of Treatment on Agni (Metabolic) Status Score: On intergroup comparison (One Way ANOVA), the result was statistically insignificant in BT ($p>0.05$). In AT, there is highly significant difference ($p=0.000$) between the net changes in Agni status score between the Group A & B and A & C with the trial treatment (Post-Hoc). The difference in mean reduction was highest in group B (6.53) followed by group C (6.39) and Group A (-0.84) respectively. (Table 12)

Table 1: Effect of Treatment on BMI

Groups	BMI Mean ±SD		Within the Group Comparison, Paired 't' Test, (BT - AT)
	BT	AT	
Group A (n=19)	32.10 ± 4.26	31.81 ± 4.48	0.29 ± 0.77 t = 1.65 p = 0.115 NS
Group B (n=19)	30.86 ± 4.53	29.79 ± 4.58	1.07 ± 0.72 t =6.46 p =0.000 HS
Group C (n=18)	33.62 ± 6.40	32.58 ± 6.24	1.04 ± 0.76 t =5.78 p =0.000 HS
Between the Group Comparison, One- Way ANOVA	F =1.34 p= 0.269 NS	F =1.47 p=0.240 NS	–
Post-Hoc Test (Bonferroni), Significant Pairs (p<0.05)	—	—	—

Table 2: Effect of Treatment on SBP

Groups	SBP Mean ±SD				Within the Group Comparison, Paired 't' Test, (BT - FU3)
	BT	FU1	FU2	FU3	
Group A (n=19)	127.68 ± 18.21	128 ± 13.58	124.21 ± 13.21	125.68 ± 10.63	2.00 ± 11.60 t =0.751 p =0.462 NS
Group B (n=19)	136.37 ± 13.66	128.42 ± 13.99	128.32 ± 11.51	129.26 ± 6.97	7.10 ± 10.8 t =2.87 p=0.010 HS
Group C (n=18)	139.78 ± 10.91	133.44 ± 9.67	130.33 ± 9.44	131.56 ± 9.44	8.22 ± 8.59 t =4.06 P =0.001 HS
Between the Group Comparison, One- Way ANOVA	F=3.39 p=0.041 S	F=1.06 p=0.335 NS	F=1.36 p=0.265 NS	F=1.948 p=0.153 NS	–
Post-Hoc Test (Bonferroni), Significant Pairs (p<0.05)	(A, C)	—	–	—	—

Table 3: Effect of Treatment on DBP

Groups	DBP Mean ±SD				Within the Group Comparison, Paired 't' Test, (BT - FU3)
	BT	FU1	FU2	FU3	
Group A (n=19)	84.74 ± 9.87	83.79 ± 7.05	82.95 ± 5.63	81.79 ± 5.97	2.95 ± 4.73 t =2.71 p = 0.014 S
Group B (n=19)	87.37 ± 7.51	81.16 ± 7.40	82.00± 6.53	80.84 ± 6.81	6.53 ± 10.6 t = 2.69 p=0.015 S
Group C (n=18)	87.06 ± 6.57	84.11 ± 7.04	84.33 ± 4.24	85.44 ± 3.81	1.61 ± 6.05 t =1.13 p=0.274 NS

Table 3: Contd.,

Between the Group Comparison, One- Way ANOVA	F=0.591 p=0.558 NS	F=0.958 p=0.390 NS	F=0.818 p=0.447 NS	F=3.32 p=0.044 S	–
Post-Hoc test (Bonferroni), Significant Pairs (p<0.05)	—	—	_	(B,C)	—

Table 4: Effect of Treatment on FBS

Groups	FBS Mean ±SD				Within the Group Comparison, Paired 't' Test, (BT - FU3)
	BT	FU1	FU2	FU3	
Group A (n=19)	107.95 ± 30.13	107.89 ± 21.75	102.84 ± 26.11	106.53 ± 26.73	1.42 ± 9.18 t =0.674 p =0.509 NS
Group B (n=19)	107.21 ± 31.44	97.42 ± 9.26	101.89 ± 16.31	98.53 ± 16.97	8.68 ± 21.19 t = 1.79 p=0.09 NS
Group C (n=18)	114.78 ± 24.40	112.0 ± 27.37	111.11 ± 18.78	107.06 ± 19.24	7.72 ± 17.25 t = 1.90 p=0.07 NS
Between the Group Comparison, One- Way ANOVA	F=0.382 p=0.684 NS	F=2.45 p=0.096 NS	F=1.08 p=0.346 NS	F=0.935 p=0.399 NS	–
Post-Hoc Test (Bonferroni), Significant Pairs (p<0.05)	—	—	_	—	—

Table 5: Effect of Treatment on PPBS

Groups	PPBS Mean ±SD				Within the Group Comparison, Paired 't' Test, (BT - FU3)
	BT	FU1	FU2	FU3	
Group A (n=19)	168.0 ± 53.70	162.68 ± 46.62	163.26 ± 44.56	167.47 ± 42.03	0.53 ± 23.10 t = 0.10 p =0.922 NS
Group B (n=19)	155.32 ± 47.21	146.16 ± 29.59	151.79 ± 32.50	142.05 ± 20.74	13.26 ± 40.78 t =1.42 p= 0.173 NS
Group C (n=18)	167.83 ± 41.89	168.94 ± 41.11	158.56 ± 37.35	157.61 ± 33.34	10.22 ± 22.52 t = 1.925 p =0.071 NS
Between the Group Comparison, One-Way ANOVA	F=0.434 p=0.650 NS	F=1.64 p=0.204 NS	F=0.427 p=0.655 NS	F=2.83 p=0.068 NS	–
Post-Hoc Test (Bonferroni), Significant Pairs (p<0.05)	—	—	_	—	—

Table 6: Effect of treatment on Serum Cholesterol

Groups	Sr. Cholesterol Mean ±SD				Within the Group Comparison, Paired 't' Test, (BT - FU3)
	BT	FU1	FU2	FU3	
Group A (n=19)	212.95 ± 79.6	198.42 ± 71.3	200.26 ± 76.81	207.11 ± 73.34	5.84 ± 23.14 t =1.10 p =0.29 NS
Group B (n=19)	202.74 ± 52.6	198.53 ± 44.0	190.11 ± 37.7	177.11 ± 37.8	25.63 ± 22.40 t =4.10 p=0.000 HS
Group C (n=18)	208.67 ± 71.32	198.94 ± 64.2	195.11 ± 61.34	186.94 ± 57.1	21.72 ± 22.95 t =4.01 p =0.001 HS

Table 6: Contd.,

Between the Group Comparison, One-Way ANOVA	F=0.106 p=0.90 NS	F=0.00 p=1.00 NS	F=0.133 p=0.876 NS	F=1.32 p=0.275 NS	–
Post-Hoc Test (Bonferroni), Significant pairs (p<0.05)	—	—	–	—	—

Table 7: Effect of treatment on Serum Triglyceride

Groups	Sr. Triglyceride Mean ±SD				Within the Group Comparison, Paired 't' Test, (BT - FU3)
	BT	FU1	FU2	FU3	
Group A (n=19)	180.63 ± 62.93	163.58 ± 50.68	162.89 ± 54.39	175.74 ± 54.27	4.89 ± 25.92 t = 0.823 p =0.421 NS
Group B (n=19)	177.68 ± 71.12	164.11 ± 47.60	152.74 ± 48.45	150.68 ± 47.52	27.00 ± 40.37 t = 2.92 p=0.009 HS
Group C (n=18)	153.17 ± 43.58	149.06 ± 40.58	145.89 ± 39.81	136.33 ± 36.24	16.83 ± 14.58 t = 4.90 p=0.000 HS
Between the Group Comparison, One-Way ANOVA	F=1.12 p=0.334 NS	F=0.616 p=0.544 NS	F=0.588 p=0.559 NS	F=3.38 p=0.042 S	–
Post-Hoc Test (Bonferroni), Significant pairs (p<0.05)	—	—		(A,C)	—

Table 8: Effect of Treatment on Serum HDL

Groups	Sr. HDL Mean ±SD				Within the Group Comparison, Paired 't' Test, (BT - FU3)
	BT	FU1	FU2	FU3	
Group A (n=19)	43.32 ± 10.62	45.21 ± 8.77	45.68 ± 8.92	44.26 ± 9.25	-0.95 ± 4.50 t = -0.92 p = 0.371 NS
Group B (n=19)	38.95 ± 10.72	40.74 ± 8.05	44.26 ± 8.63	44.21 ± 7.77	-5.26 ± 5.84 t = -3.93 p=0.001 HS
Group C (n=18)	44.11 ± 9.05	40.39 ± 7.69	46.22 ± 9.32	45.56 ± 7.38	-1.44 ± 7.60 t = -0.806 p=0.431 NS
Between the Group Comparison, One- Way ANOVA	F=1.4 p=0.256 NS	F=2.03 p=0.142 NS	F=0.238 p=0.789 NS	F=0.159 p=0.854 NS	–
Post-Hoc Test (Bonferroni), Significant Pairs (p<0.05)	—	—	–	—	—

Table 9: Effect of treatment on Serum LDL

Groups	Sr. LDL Mean ±SD				Within the Group Comparison (BT - FU3)
	BT	FU1	FU2	FU3	
Group A (n=19)	122.0 ± 69.07	114.79 ± 64.05	113.47 ± 61.12	123.74 ± 64.91	-1.74 ± 22.98 z**= 0.36 p =0.72 NS
Group B (n=19)	116.74 ± 33.65	109.0 ± 30.16	109.16 ± 33.75	103.42 ± 27.15	13.32 ± 21.47 t* = 2.70 p=0.015 S

Table 9: Contd.,

Group C (n=18)	114.83 ± 59.44	106.72 ± 53.42	106.56 ± 48.89	98.56 ± 47.59	16.28 ± 21.11 z**= 2.69 p =0.007 HS
Between the Group Comparison, One-Way ANOVA	F=0.08 p=0.921 NS	F=0.123 p=0.885 NS	F=0.09 p=0.911 NS	F=1.39 p=0.259 NS	–
Post-Hoc test (Bonferroni), Significant pairs (p<0.05)	—	—	–	—	—

*paired "t" test **wilcoxon signed rank test

Table 10: Effect of Treatment on Serum VLDL

Groups	Sr. VLDL Mean ±SD				Within the Group Comparison (BT - FU3)
	BT	FU1	FU2	FU3	
Group A (n=19)	43.05 ± 20.07	46.11 ± 17.37	43.47 ± 14.91	44.89 ± 14.81	-1.84 ± 9.67 t* = -0.83 p =0.417 NS
Group B (n=19)	49.58 ± 24.54	43.47 ± 16.67	39.89 ± 14.30	40.58 ± 15.02	9.00 ± 14.14 z**= 2.13 p =0.033 S
Group C (n=18)	39.61± 28.31	45.56 ± 38.38	37.94 ± 13.36	36.50 ± 12.88	3.11 ± 22.72 z**= 0.68 p =0.50 NS
Between the Group Comparison, One-Way ANOVA	F=0.797 p=0.456 NS	F=0.054 p=0.947 NS	F=0.723 p=0.490 NS	F=1.6 p=0.212 NS	–
Post-Hoc test (Bonferroni), Significant pairs (p<0.05)	—	—	–	—	—

*paired "t" test **wilcoxon signed rank test

Table 11: Effect of Treatment on Ojas Scale

Groups	Ojas Mean ±SD		Within the Group Comparison, Paired 't' Test, (BT - AT)
	BT	AT	
Group A (n=19)	11.32 ± 3.43	11.74 ± 3.51	-0.42 ± 0.69 t =-2.65 p =0.016 HS
Group B (n=19)	8.89 ± 1.97	5.53 ± 1.17	3.37 ± 1.42 t =10.32 p =0.000 HS
Group C (n=18)	10.33 ± 2.27	5.72 ± 1.56	4.61 ± 1.85 t =10.57 p =0.000 HS
Between the Group Comparison, One- Way ANOVA	F =4.03 p=0.023 S	F =43.22 p=0.000 HS	–
Post-Hoc test (Bonferroni), Significant pairs (p<0.05)	(A,B)	(A,B) (A,C)	—

Table 12: Effect of Treatment on Agni Scale

Groups	Agni Mean ±SD		Within the Group Comparison, Paired 't' Test, (BT - AT)
	BT	AT	
Group A (n=19)	13.05 ± 2.01	13.89 ± 2.28	-0.84 ± 0.76 t = -4.80 p =0.000 HS

Table 12: Contd.,

Group B (n=19)	12.68 ± 1.80	6.16 ± 1.01	6.53 ± 1.71 t = 16.62 p =0.000 HS
Group C (n=18)	13.78 ± 2.82	7.39 ± 2.03	6.39 ± 1.88 t = 14.39 p =0.000 HS
Between the Group Comparison, One-Way ANOVA	F =1.13 p= 0.33 NS	F =94.86 p=0.000 HS	_
Post-Hoc test (Bonferroni), Significant pairs (p<0.05)	—	(A,B) (A,C)	—

DISCUSSIONS

The present clinical study has been undertaken with aims to laid down scientific overview on Metabolic syndrome as per conventional and Ayurvedic parlance. Beside this, it also aims to conduct an open clinical trial of an Ayurvedic drug Pushkarmūla in cases of metabolic syndrome comparing the rate and quality of treatment response with a control group receiving conventional modern treatment. The exact mechanism of complex pathways of MS is not yet completely known but high calorie diet, faulty lifestyle, stressors, central obesity, endocrine disorders, aging along with genetic factors contribute a lot in the patho- physiology of MS. It is believed that adipocytes of visceral fat increases plasma level of TNF-α and alters the level of others substances (adiponectin, leptin, resistin, PAI-1,homocysteine etc).[15,16] which plays a series of event of chronic inflammation that may lead to increased risk of developing hypertension, atherosclerosis, diabetes.[17,18]

This specific trend warrants further studies to throw light on its mode of action. Besides, it also warrants following areas of future research.

- Laid down critical conceptual frame of metabolic syndrome in relation to Ayurveda.
- To develop possible mode of action as per Ayurvedic pharmacodynamics.
- To assess the impact of Deha (Genetic constitution) & Manasa Prakrti (Psychological status), Oja bala (Immunity status) and Agni bala (Metabolic status) on different component of MS.
- To develop relationship of blood pressure to the other components of the syndrome.
- To demonstrate relationship between different constellations of factors to CVD outcomes.
- To develop relationship of simple and complex measures of the components of the metabolic syndrome to clinical events.
- The effective treatment of all components of the syndrome on CVD risk.
- Better identification of high risk patients with metabolic syndrome under different sets of Prakrti.

PROBABLE MODE OF ACTION OF INULA RACEMOSA

- Among all the active constituents of Inula racemosa, sesqueterpenes (mainly Alantolactone and isoalantolactone) is the most important and major constituent.
- When it is administrated in the doses of 100-200 mg/kgbw/day in albino rates for cosicuative 21 days, showing improvement in cardiac function by increasing heart rate, mean arterial pressure and relaxation along with decrease LVEDV.[14]
- It also significantly restored the reduced form of glutathione and antioxident enzymes like superoxide dismutase, catalase, and glutathione peroxidase from heart which are depleted after myocardial injury.[14]
- Allantolactone significantly inhibits the lipid peroxidation and prevents the leakage of various chemical mediators in the myocardium.
- Allantolactone increase the activity of antioxident enzymes in the cardiac muscles. It also prevents depletion of reduced glutathione, which acts as a direct scavenger of reactive oxygen species.
- Because of its antioxidant property, Allantolactone subsequently decreases the chances of atherosclerosis and promotes the synthesis of HDL lipoprotein.

CONCLUSIONS

The management of metabolic syndrome in conventional system of medicine is still not satisfactory and warranting newer strategies from other resources. It seems to explore an Ayurveda-inspired line of management for treating MS and preventing its life threatening complications.

In the present clinical work, Pushkarmūla is selected as trial drug for treatment of MS, because of its cardio protective, antioxidant and lipid per-oxidation inhibition properties. The drug has been selected as trial drugs based on certain recent experimental, pharmacological and clinical studies. Thus on the basis of observations made in the present study it can be concluded that Metabolic syndrome is well defined and still evolving etiopathogenesis in biomedical sciences, is as such not described in *Ayurvedic* classics, but it may be considered as the *Meda* (Lipids) dominant disorder and having strong resemblance with *Prameha* (Diatetes Mellitus) and *sthulya* (Obesity). The conventional management of metabolic syndrome is still not very satisfactory and the current strategy of prevention and treatment of metabolic syndrome is rapidly changing. Hence many investigators in this field are inclined to undertake scientific study in treatment development from *Ayurvedic* resources. The present study has been under taken with the same perspective. Pushkarmūla treated patients have shown significant correction in Lipid profile besides noticeable improvement in blood pressure, waist circumference, FBS and PPBS along with Hepatic, Renal and cardiac protection.

The leads available from the present work open a new dimension to the understanding and management of metabolic syndrome and to prevent its major cardiovascular and other metabolic complications by applying on larger sample of populations on scientific parameters. The approach used in this study seems to be effective and completely safe because no unwanted effects were noted during the whole study period.

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